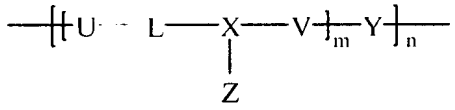
What is claimed is:

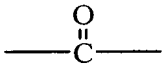
1. A biodegradable cationic polymer, which has amino groups in a backbone and side chains for delivering nucleic acids into a cell, and a formula (V_a) of the biodegradable cationic polymer shown as below:



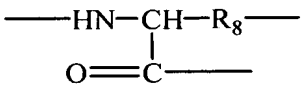
(V_a),

wherein

U is $(R_1-O)_d$, in which R_1 is a C_2-C_{20} alkylene or substituted alkylene radical, d is an integer of 4 to 200,

L is  ,

X is an amino acid group containing additional amino or amide group of the formula (II_a):

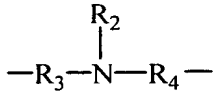


(II_a),

in which R_8 is selected from the group consisting of $-CH_2CONH_2-$, $-CH_2CH_2CONH_2-$, and $-CH_2CH_2CH_2NH_2-$,

V is $-COO-$,

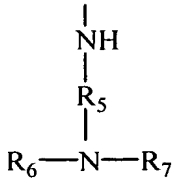
Y is an amino group of the formula (VI_a):



(VI_a),

in which R_2 is hydrogen or C_1-C_{20} alkyl radical, R_3 and R_4 is the same C_1-C_{20} alkylene radical,

Z is an another amino group of the formula (VII_a):



(VII_a),

in which R_5 is C_2-C_{20} alkylene radical, R_6 and R_7 are the same or different C_1-C_5 alkyl radicals,

m is an integer of 1 to 10, and

n is an integer of 1 to 20.

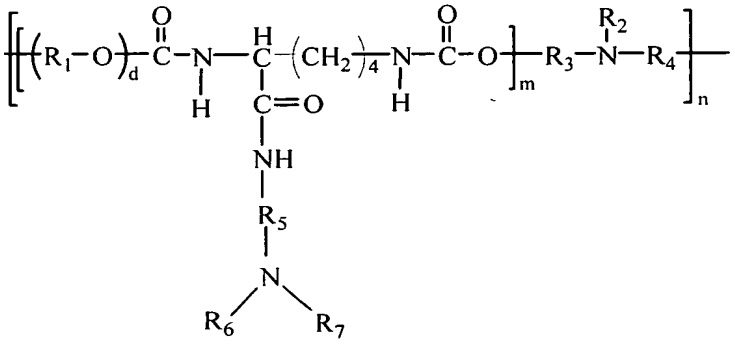
2. The biodegradable cationic polymer of claim 1, wherein R_1 is selected from the group consisting of C_2-C_5 alkylene radicals.

3. The biodegradable cationic polymer of claim 2, wherein R_1 is ethylene radical, d is an integer of 4 to 200.

4. The biodegradable cationic polymer of claim 2, wherein R_1 is propylene radical, d is an integer of 9 to 34.

5. The biodegradable cationic polymer of claim 1, wherein X is preferably —$CH_2CH_2CH_2NH_2$—.

6. A biodegradable cationic polymer, which has amino groups in a backbone and side chains for delivering nucleic acids into a cell, and a formula (V) of the biodegradable cationic polymer shown as below:



(V),

wherein

R_1 is a C_2-C_{20} alkylene or substituted alkylene radical, d is an integer of 4 to 200,

R_2 is hydrogen or C_1-C_{20} alkyl radical,

R_3 and R_4 is the same C_1-C_{20} alkylene radical,

R_5 is C_2-C_{20} alkylene radical,

R_6 and R_7 is the same or different C_1-C_5 alkyl radical,

m is an integer of 1 to 10, and

n is an integer of 1 to 20.

7. The biodegradable cationic polymer of claim 6, wherein R_1 is selected from the group consisting of C_2-C_5 alkylene radicals.

8. The biodegradable cationic polymer of claim 7, wherein R_1 is ethylene radical, d is an integer of 4 to 200.

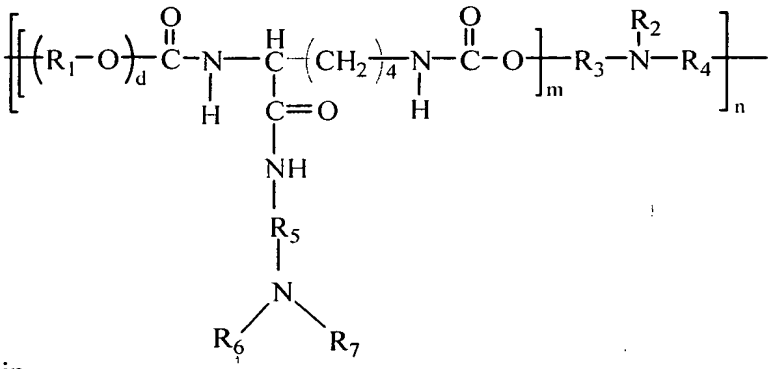
9. The biodegradable cationic polymer of claim 7, wherein the R_1 is propylene radical, d is an integer of 9 to 34.

10. A method of making biodegradable cationic polymer, which has amino groups in a backbone and side chains for delivering nucleic acids into a cell; and the method of making a biodegradable cationic polymer comprises:

performing a polymerization, which reacts L-lysine methyl ester diisocyanate (LDI) with a polyol until a first NCO/OH molar ratio in anhydrous dimethyl formamide (DMF) at 75 to 85 ℃, to obtain an isocyanate-terminated prepolymer ;

performing a chain extension reaction, which has decrease of 0 to 10 ℃, then adds the chain extender slowly to the prepolymer until a second NCO/OH molar ratio, and an organotin compound is used as a catalyst at 75 to 85℃ for approximately 120 min, to obtain a polyurethane having an alkoxide group provided by LDI; and

performing an aminolysis reaction, which the alkoxide group of the polyurethane (IV) is replaced by an amino group with another amine, to obtain the biodegradable cationic polymer, which has a formula (V):



(V),

wherein

R_1 is a C_2-C_{20} alkylene or substituted alkylene radical, d is an integer of 4 to 200,

R_2 is hydrogen or C_1-C_{20} alkyl radical,

R_3 and R_4 is the same C_1-C_{20} alkylene radical,

R_5 is C_2-C_{20} alkylene radical,

R_6 and R_7 is the same or different C_1-C_5 alkyl radical,

m is an integer of 1 to 10, and

n is an integer of 1 to 20.

11. The method of making biodegradable cationic polymer of claim 10, wherein the polyol is selected from the group consisting of polyethylene glycol (PEG),

polypropylene glycol (PPG), polytetramethylene glycol (PTMG) and polytetramethylene ester glycol (PTMEG).

12. The method of making biodegradable cationic polymer of claim 11, wherein the PEG has a degree of polymerization of 4 to 200.

13. The method of making biodegradable cationic polymer of claim 11, wherein the PPG has a degree of polymerization of 9 to 34.

14. The method of making biodegradable cationic polymer of claim 10, wherein the polymerization reaction is preferred at approximately 80℃.

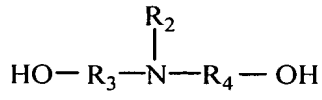
15. The method of making biodegradable cationic polymer of claim 10, wherein the first NCO/OH molar ratio is approximately 2/1.

16. The method of making biodegradable cationic polymer of claim 10, wherein the second NCO/OH molar ratio is approximately 1/1.

17. The method of making biodegradable cationic polymer of claim 10, wherein the chain extension reaction is preferred at approximately 80℃.

18. The method of making biodegradable cationic polymer of claim 10, wherein the chain extension reaction is preferably performed for approximately 120 minutes.

19. The method of making biodegradable cationic polymer of claim 10, wherein the chain extender is an amine of the formula (VI):



(VI),

wherein R_2 is hydrogen or C_1-C_{20} alkyl radical, and R_3 and R_4 is the same C_1-C_{20} alkylene radical.

20. The method of making biodegradable cationic polymer of claim 19, wherein the chain extender is N-methyldiethanolamine (MDEA).

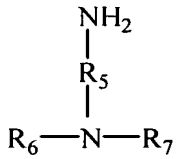
21. The method of making biodegradable cationic polymer of claim 10, wherein the organotin compound is dibutyltin dilaurate.

22. The method of making biodegradable cationic polymer of claim 21, wherein the organotin compound is added in 0.1 to 1 weight percent (wt %).

23. The method of making biodegradable cationic polymer of claim 21, wherein the organotin compound is added in 0.5 wt %.

24. The method of making biodegradable cationic polymer of claim 10, wherein the alkoxide group is methyloxide group.

25. The method of making biodegradable cationic polymer of claim 10, wherein the another amine presents a formula (VII):



(VII),

wherein R_5 is C_2-C_{20} alkylene radical, and R_6 and R_7 is the same or different C_1-C_5 alkyl radical.

26. The method of making biodegradable cationic polymer of claim 25, wherein the another amine is N,N-Diethylethylenediamine (DEDA).

27. The method of making biodegradable cationic polymer of claim 10, wherein a molecular weight (MW) of the biodegradable cationic polymer is 6000 to 62000.

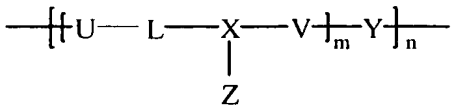
28. The method of making biodegradable cationic polymer of claim 10, wherein the nucleic acids are encoded a gene, and the nucleic acids are selected from the group consisting of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

29. A method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell, and the method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell comprises:

forming complexes with the nucleic acids and the biodegradable cationic polymer; and

applying the complexes to the cell for delivering the nucleic acids into the cell by endocytosis;

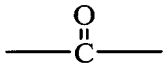
wherein the biodegradable cationic polymer has a formula (V_a):



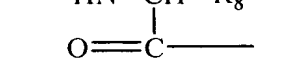
(Va),

in which

U is $(R_1-O)_d$, in which R_1 is a C_2-C_{20} alkylene or substituted alkylene radical, d is an integer of 4 to 200,

L is  ,

X is an amino acid group containing additional amino or amide group of the formula (IIa):

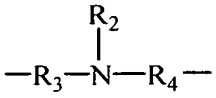


(IIa),

in which R_8 is selected from the group consisting of $-CH_2CONH_2-$, $-CH_2CH_2CONH_2-$, and $-CH_2CH_2CH_2NH_2-$,

V is $-COO-$,

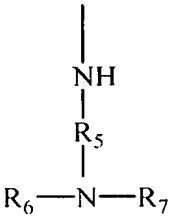
Y is an amino group of the formula (VIa):



(VIa),

in which R_2 is hydrogen or C_1-C_{20} alkyl radical, R_3 and R_4 is the same C_1-C_{20} alkylene radical,

Z is an another amino group of the formula (VIIa):



(VIIa),

in which R_5 is C_2-C_{20} alkylene radical, R_6 and R_7 are the same or different C_1-C_5 alkyl radicals,

m is an integer of 1 to 10, and

n is an integer of 1 to 20.

30. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein R_1 is selected from the group consisting of C_2-C_5 alkylene radicals.

31. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 30, wherein R_1 is ethylene radical, d is an integer of 4 to 200.

32. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 30, wherein R_1 is propylene radical, d is an integer of 9 to 34.

33. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein a mass ratio of the biodegradable cationic polymer to the nucleic acids is 1/1 to 50/1.

34. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein a mass ratio of the biodegradable cationic polymer to the nucleic acids is 5/1 to 30/1.

35. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein a mass ratio of the biodegradable cationic polymer to the nucleic acids is 20/1.

36. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein the nucleic acids are encoded a gene, and the nucleic acids are selected from the group consisting of DNA and RNA.

37. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 36, wherein the DNA is selected from the group consisting of double-stranded DNA, single-stranded DNA and synthetic oligonucleotides.

38. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 36, wherein the RNA is selected from the group consisting of sense RNA, anti-sense RNA and ribozyme RNA.

39. The method of using biodegradable cationic polymer for in vitro delivering nucleic acids into a cell of claim 29, wherein the cell is selected from the group consisting of primary cells and tumor cells.